A Proposal For:
Bat Use of Highway Structures: A Pilot Study

Submitted by

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Submitted to

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Background Summary

Bats provide major economic and ecological benefits through their role as primary predators of nocturnal insects. Many species of North American bats have experienced alarming population declines in past decades due to widespread destruction of natural roosting sites in caves and large trees and from land use changes causing extensive loss of foraging habitat (Pierson 1998). Of 45 bat species in the U.S., six are now federally listed and 20 others are considered species of concern (Harvey et al. 1999), including seven Montana species that occur in the MDT Billings District. Recently, bats that have abandoned traditional natural roosts for man-made alternatives have also been negatively affected, e.g. by mine reclamation (Tuttle and Taylor 1994).

Highway bridges and culverts have come to provide important roosting habitat for bats in many areas (Keeley and Tuttle 1999). Highway structures were only recently recognized as roosting habitat for bats (Davis and Cockrum 1963), and systematic survey of their use is still in its infancy (e.g., Pierson et al. 1996, Keeley and Tuttle 1996, Keeley and Tuttle 1999, Adam and Hayes 2000). Results of these few studies, all conducted in other states, show that joints between structural components of bridges (especially concrete spans) and some highway culverts serve as sites for day or night roosts and maternity roosts. Research has also been initiated to develop methods for mitigating disturbances to bats when highway structures are repaired or replaced. Some recent methods are very promising (see Keeley and Tuttle 1999, Arnett and Hayes 2000).

At least five Montana bat species of concern use bridges for roosts in the western United States (Keeley and Tuttle 1999). However, little is known about the extent or frequency of bridge use in Montana, when bridges are used or why, and which kinds of structures are preferred. As bridges across Montana are repaired or replaced, bat roosts could be unknowingly destroyed. The proposed research will provide the Montana Department of Transportation information to both manage bats already occurring in highway structures and manage highway structures to provide habitat for bats.

Objectives

1) Provide MDT with information on the frequency of highway structure use by bats in the southern portion of the Billings District.

2) Identify adjacent landscape attributes (e.g., distance to water, adjacent land use) and highway structure design features (e.g., span dimensions, design materials, span type, etc.) that will enable MDT to identify settings where bats are most likely to use highway structures for roosts, and identify additional structures suitable for enhancement projects.

3) Establish the basis for future inventories by MDT of highway structure use. Survey protocols and methodology will be developed and fine-tuned, and will be applicable to similar studies and inventories throughout the state.

Benefits

This project will provide MDT with the knowledge and mitigation tools to address bat conservation/protection issues as they arise during routine highway structure inspections, as well as during highway structure repair or construction activities. We anticipate that the patterns of highway structure use by bats identified in the Billings District will be broadly applicable across the state, and will guide similar highway surveys elsewhere.

Specifically, MDT will have current information on the landscape context where the bridge and culvert designs most favored by bats are likely to be used. The types of structures preferred by bats in Montana will probably be similar to preferences found in other areas of the country. However, bridge use within the context of surrounding landscapes has not been identified. With this information the implementation of activities to mitigate disturbance of bats along highways will be much more effective for those specific situations where bat protection is a concern. Furthermore, the information generated by this study can guide MDT in proactive conservation projects by identifying locations where bat enhancement activities at highway structures are more likely to be successful. We will also provide measures for mitigation for construction activities that may impact bats using bridge structures as well as guidelines for discouraging bridge use by bats.

Research Plan

This pilot project will be conducted in the Billings area (southern part) of the MDT Billings District. This area was selected because 1) the greatest diversity of bats in Montana occurs here, 2) the area provides a variety of landscapes adjacent to roadways that permit analyses of land cover influences on highway structure use, and 3) a variety of bridge types are present in sufficient numbers to allow quantitative comparisons between bridge categories.

Structures to be examined for bat use will be selected based on a stratified random selection process. The MDT online bridge inventory book will be used to classify bridges in the area by construction type; bridges to be examined will be randomly selected within each bridge type. Other highway structures already known to harbor bats or where bat use is most likely (based on material and construction) will also be examined.

Approximately 100 highway structures of 4-5 types will be assessed during summer and early autumn for bat-use, following BCI protocols for bridge and culvert surveys (Keeley and Tuttle 1999). Each structure will be inspected for bats, guano, staining or other evidence of use. Inspection of hard-to-reach gaps at span joints and other locations on the undersides of bridges will be aided by use of a miniature video-board camera device mounted on an extendible pole (Proudfoot 1996). Location of use within each highway structure, and an estimate of the intensity of use as either a day or night roost will be recorded. Structures will be assigned a construction category, location recorded with a

GPS unit, and span/culvert dimensions, height above ground or water recorded for each inspected structure. Using GIS, landscapes up to two miles radius around each bridge would be analyzed for vegetation cover-type patterns, number of standing water bodies (foraging sites), and the number of additional bridges.

Following initial inspection, a subset showing greatest bat use will be revisited for additional monitoring (electronic bat detector, netting or hand-capture) and identification of species present. These data allow assessment of bridge/culvert use by bats of different species based on construction type, bridge/culvert size, part of bridge/culvert favored for roosting, distance to water, number of other bridges or culverts nearby, and surrounding vegetation land-cover (especially amount of mature trees and cropland).

Products

Deliverables will include a final report documenting the finding of the research. In addition quarterly progress reports will be submitted. A draft final report will also be submitted to DOT for review.

Findings of this study will be summarized as descriptive models of highway structures where bat use is most prevalent and most likely. For example:

> Preferred structures are concrete spans at least 4 meters above the ground, not over water, with 4 cm spaces between span sections. These structures are used only where the surrounding landscape within a two-mile radius includes at least 5% mature cottonwood riparian and <10% cropland, and a minimum of two additional concrete spans.

The report will also summarize relevant results from research conducted in other areas. In addition, we will provide written mitigation guidelines for situations where bat use of preferred highway structures could conflict with MDT activities.

Implementation

Research results are intended for use and application by MDT engineers with collaboration from MDT biologists. Findings will be suitable for immediate application. Because bat use of highway structures may vary elsewhere in the state, we recommend extending this work to other parts of Montana, focusing in particular on different landscape settings.

Time Schedule.

This project will begin during the summer of 2002 with initial survey method testing. The majority of the fieldwork is projected to begin during the summer of 2003. The draft final report due date will be February 1, 2004 for MDT review and the final report will be due May 1, 2004.

Task Description	Month- 0	3	6	9	12	15	18	21	24
1. site selection	* * *								
2. field surveys		* * * *			****				
3. data entry			* * *	* * *		****			
4. analysis							*********		
5. report preparation/review								*********	

Staffing

John Carlson, the principle investigator, is Zoology Program Manager for the Montana Natural Heritage Program and is a PhD candidate at Montana State University. He received his B.A. in Zoology from the University of Montana and his M.S. in Zoology and Physiology from the University of Wyoming. He has extensive international field experience conducting biological surveys and is in the process of conducting extensive bat survey work in south-central Montana.

Paul Hendricks is Assistant Zoologist with the Montana Natural Heritage Program. He received B.A. and M.A. degrees in Zoology from the University of Montana and a Ph.D. in Zoology from Washington State University. He has broad field experience throughout North America with a variety of vertebrate and invertebrate species. Field work in recent years with the MTNHP has included numerous surveys for bats in caves, abandoned mines, forests, and one highway corridor survey in Yellowstone National Park, using a variety of survey methods (trapping, ANABAT electronic bat detector technology, visual underground and structure inspection techniques). He has published over 30 papers on the fauna of Montana, including a recent paper on the bats of Azure Cave and the Little Rocky Mountains.

Name	Role in Study	Task -1	2	3	4	5	total
John Carlson	Zoologist/Principle Investigator	24	176	0	40	96	336
Paul Hendricks	Assistant Zoologist/ Co-Principle Investigator	40	176	24	40	96	376
Whitney Weber	Database Coordinator	0	0	0	90	42	132
Alan Cox	Systems & Services Mngr.	0	0	0	36	0	36
Cathy Jean	Ecologist	0	0	0	0	16	16
Data/Project Support	Data processing support	0	0	128	0	32	160
Field Biologist	Field work	0	176	0	0	0	176
		64	528	152	200	288	1232

Facilities.

Analysis and GIS work will be accomplished with facilities and equipment on hand at NRIS/MTNHP. No equipment item costing more than $1,000 is needed. Equipment under $1,000 is included in the supplies budget line.

MDT involvement.

MTNHP zoologists will consult with MDT Billings District biologists on project progress and logistics. Additional consultation with an MDT bridge inspector may be needed to select highway structures for inspection during this project.

Budget.

Item	State Fiscal Year	2003	2004
Personnel Total		$17,938	$17,939
Travel		$1913	$1914
Equipment > $1,000		$0	$0
Supplies Total		$3,576	$1000
Contractual		$0	$300
Training		$1326	$0
Communication		$30	$30
Printing		$0	$400
Miscellaneous Other		$100	$100
Sub-Total		$24,883	$21,683
Indirect Costs - 16%		$3725	$3726
TOTAL		$28,608	$25,409

Item	Federal Fiscal Year	2002	2003	2004
Personnel Total		$3,000	$27,877	$5,000
Travel		$413	$3,414	$0
Equipment > $1,000		$0	$0	$0
Supplies Total		$3,576	$1000	$0
Contractual		$0	$300	$0
Training		$1326	$0	$0
Communication		$30	$30	$0
Printing		$0	$0	$400
Miscellaneous Other		$100	$100	$0
Sub-Total		$24,884	$16,283	$5,400
Indirect Costs - 16%		$3981	$2605	$864
TOTAL		$28,865	$18,888	$6,264

References.

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